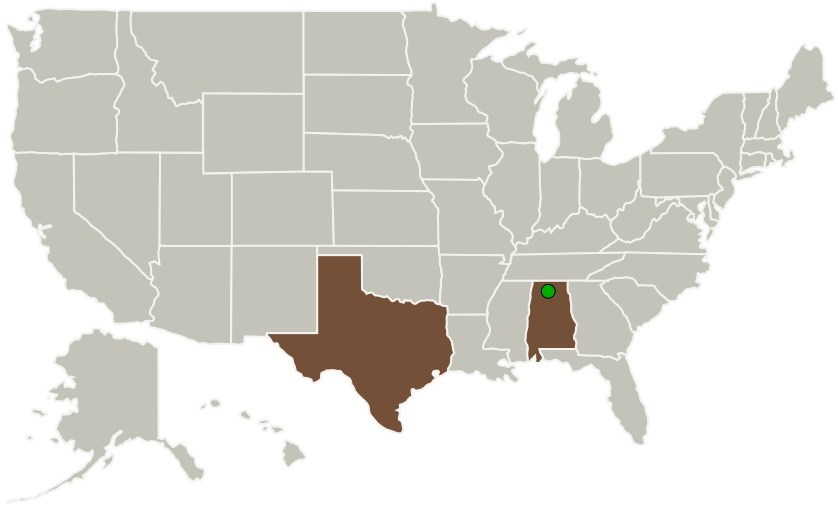
Drastic Improvements in Bonding of Fiber Reinforced Multifunctional Composites, Phase I

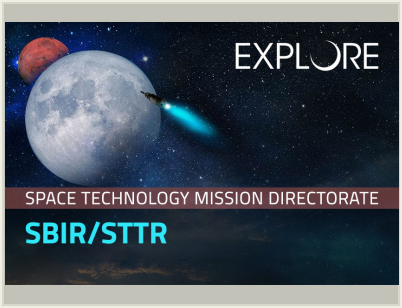
Completed Technology Project (2010 - 2010)

Project Introduction

Achievement of a dramatic increase in the bond strength in the composite/adhesive interfaces of existing fiber reinforced polymer (FRP) composite material joints and structures suitable for NASA applications is the main goal of this Phase I project. The Phase II project will focus on implementation of the proposed technology for newest materials developed up to date and scaling of the proposed technology to large area and complex shape FRP composite structural joints. The proposed technology developed at Integrated Micro Sensors Inc is based on laser-assisted fabrication of Micro Column Arrays (MCA) on the surface of the two materials prior to bonding. There are several advantages of the MCA technology in the drastic improvement of bonds between any similar and dissimilar materials. First, mechanical strength increases due to interlocking of the adhesive or brazing material between micro columns. Second, the bond strength increases due to the increase of the specific surface area by more than an order of magnitude. Third, stability increases due to the inherent elasticity of the micro cones during a deformation that can occur due to stresses induced by difference in thermal expansion between the material and adhesive or braze or under shear stress). Fourth, increase in the bond durability because of the repeated bend contours of the surface preventing hydrothermal failure. Fifth, wettability of the material surface significantly improves due to (i) a highly developed surface morphology at the micro and submicron level resulting from rapid solidification of the material surface during laser processing, and (ii) changes in local chemistry due to surface oxidation that could be beneficial to promoting a stronger bond.

Primary U.S. Work Locations and Key Partners





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Organizations Performing Work	Role	Type	Location
Integrated Micro Sensors, Inc.	Lead Organization	Industry	Houston, Texas
Marshall Space Flight Center(MSFC)	Supporting Organization	NASA Center	Huntsville, Alabama

Primary U.S. Work Locations	
Alabama	Texas

Project Transitions

January 2010: Project Start

July 2010: Closed out

Closeout Documentation:

- Final Summary Chart*(https://techport.nasa.gov/file/140104)*

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

Integrated Micro Sensors, Inc.

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

Carlos Torrez

Principal Investigator:

David Starikov

Co-Investigator:

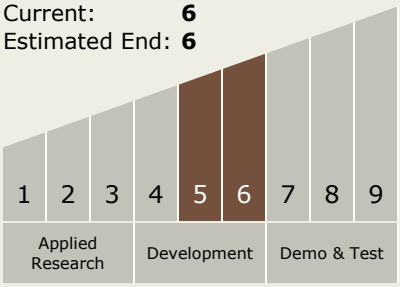
David Starikov

Drastic Improvements in Bonding of Fiber Reinforced Multifunctional Composites, Phase I

Completed Technology Project (2010 - 2010)

Technology Maturity (TRL)

Start: **5**
Current: **6**
Estimated End: **6**



Technology Areas

Primary:

- TX12 Materials, Structures, Mechanical Systems, and Manufacturing
  - TX12.1 Materials
    - TX12.1.1 Lightweight Structural Materials

Target Destinations

The Sun, Earth, The Moon, Mars, Others Inside the Solar System, Outside the Solar System